Waveland Lake
Aquatic Vegetation Management Plan
2007 Update-Draft

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Prepared for:

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Executive Summary

Aquatic Control was contracted by the Waveland Lake Department of Parks and Recreation to complete aquatic vegetation sampling in order to update their lakewide, long-term integrated aquatic vegetation management plan which was originally completed in 2005. Funding for the update of this plan was obtained from the Waveland Lake Department of Parks and Recreation and the Indiana Department of Natural Resources-Division of Fish and Wildlife as part of the Lake and River Enhancement program (LARE). The update will serve as a tool to track changes in the vegetation community, to adjust the action plan as needed, and to maintain eligibility for additional LARE funds. Items covered include; the 2005, 2006, and 2007 sampling results, as well as a review of the 2007 vegetation controls, and updates to the budget and action plans.

Aquatic vegetation is an important component of lakes in Indiana; however, as a result of many factors this vegetation can develop to a nuisance level. Nuisance aquatic vegetation, as used in this paper, is described as plant growth that negatively impacts the present uses of the lake including fishing, boating, swimming, aesthetic, and lakefront property values. The primary nuisance species within Waveland Lake is the native plant common coontail (*Ceratophyllum demersum*). Eurasian watermilfoil (*Myriophyllum spicatum*), hereafter called milfoil and curlyleaf pondweed (*Potamogeton crispus*) are exotic species found in Waveland Lake at nuisance levels. The original plan recommended a spring Tier I mapping survey followed by treatment of invasive species and treatment of native species in high use areas. A Tier II survey and additional treatment of high use areas for native vegetation would follow in the summer. Other recommendations in the original plan included the following; posting of signs at all ramps encouraging boaters to thoroughly clean their boats and trailers of all plant material to reduce the spread of exotic species.

LARE grants were not applied for in 2005 or 2006 therefore no updates were made to the plan. Plant survey data for 2005 and 2006, collected by IDNR fisheries biologist Rhett Wisener and staff, will be used to document changes in the plant community for those periods.

An Invasive Species Mapping survey was completed, prior to treatment, on May 8, 2007. This sampling indicated the presence of more than 50.0 acres of milfoil and very dense native plant growth throughout the entire littoral zone of the lake. On June 7 granular 2,4-D was applied to 50.0 acres of milfoil. This treatment was funded by LARE and the WLDPR. On June 20, 2007 contact herbicides were used to treat 20.8 acres of dense native vegetation in high use areas. This treatment was funded exclusively by WLDPR. A summer Tier II survey was completed on August 6, 2007. A total of 8 species was collected. Common coontail was the most abundant species followed by Eurasian watermilfoil. Eurasian watermilfoil had declined when compared to 2006 survey results.

It is likely that milfoil will continue to spread throughout the lake without continued monitoring and treatment. It is recommended that the Waveland Lake Department of

Parks and Recreation request $20,000 for treatment of up to 60 acres of milfoil with 2,4-D herbicide, and $4,500 for plant sampling and plan update. In addition, it is recommended that WLDPR and other effected parties fund treatment of coontail in high use areas.

Table of Contents

List of Figures

List of Tables

1.0 INTRODUCTION

This report was created in order to update the Waveland Lake Aquatic Vegetation Management Plan. The update will serve as a tool to track changes in the vegetation community, to adjust the action plan as needed, and to maintain eligibility for additional LARE funds. Items covered include the 2005, 2006, and 2007 sampling results, a review of the 2007 vegetation controls, and updates to the budget and action plans. The plan update was funded by the Indiana Department of Natural Resources Lake and River Enhancement Program (LARE) and the Waveland Lake Department of Parks and Recreation.

2.0 SAMPLING RESULTS

LARE funding was not used in 2005 or 2006 to perform aquatic plant monitoring surveys. IDNR fisheries biologists completed Tier II plant surveys in both 2005 and 2006 as part of fish community evaluation surveys. This survey data will be used to document changes in the plant community. In spring 2007 Aquatic Control completed an Invasive Species Plant Mapping survey to evaluate exotic species areas for future treatment. In August 2007, both Aquatic Control and IDNR performed separate Tier II surveys.

2.1 2005 IDNR Sampling Results

On August 11, 2005, IDNR fisheries biologist completed a Tier II aquatic plant survey on Waveland Lake. The results of the survey are listed in Table 1. A Secchi disc reading was taken and found to be 3.0 feet. Plants were collected at 97% of the sample sites. The maximum number of species of plants per site was six. Two exotic species Eurasian watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*) were collected. The average number of species per site was 2.63, and the average number of native species per site was 2.39. Nine plant species were collected, seven of which were native. Common coontail (*Ceratophyllum demersum*) was the most common species collected with a frequency of occurrence of 86.1. Coontail also had the highest dominance rating of 60.0. Southern naiad (*Najas guadalupensis*) was the ranked second, followed by American pondweed (*Potamogeton nodosus*), leafy pondweed (*Potamogeton foliosus*), Eurasian watermilfoil, brittle naiad (*Najas minor*), sago pondweed (*Potamogeton pectinatus*), Chara (*Chara spp*.), and curlyleaf pondweed.

Table 1. Occurrence and abundance of submersed aquatic plants in Waveland Lake, August 11, 2005.

Occurrence and abundance of submersed aquatic plants in Lake Waveland 2005							
County:	Parke / Montgom	Sites with plants:	70	Mean species/site:	2.63		
Date:	8/11/2005	Sites with native plants:	70	Standard error (ms/s):	0.17		
Secchi (ft):	3.0	Number of species:	9	Mean native species/site:	2.39		
Maximum plant depth (ft):	8.0	Number of native species:	7	Standard error (mns/s):	0.16		
Trophic status	Eutrophic	Maximum species/site:	6	Species diversity:	0.81		
Total sites:	72			Native species diversity:	0.78		
All depths (0 to 15 ft)	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**		
Coontail	86.1	13.9	20.8	23.6	41.7	60.0	
Southern naiad	52.8	47.2	20.8	15.3	16.7	30.0	
Filamentous algae	38.9	61.1	38.9	0.0	0.0	7.8	
American pondweed	30.6	69.4	16.7	6.9	6.9	14.4	
Leafy pondweed	30.6	69.4	25.0	4.2	1.4	8.9	
Eurasian water milfoil	22.2	77.8	16.7	4.2	1.4	7.2	
Brittle naiad	18.1	81.9	12.5	4.2	1.4	6.4	
Sago pondweed	8.3	91.7	6.9	1.4	0.0	2.2	
Naiad spp.	6.9	93.1	6.9	0.0	0.0	1.4	
Chara	5.6	94.4	1.4	2.8	1.4	3.3	
Curlyleaf pondweed	1.4	98.6	1.4	0.0	0.0	0.3	

2.2 2006 IDNR Sampling Results

On August 15, 2006, IDNR fisheries biologist completed a Tier II aquatic plant survey on Waveland Lake. The results of the survey are listed in Table 2. A Secchi disc reading was taken and found to be 3.0 feet. Plants were collected at 84% of the sample sites. Nine plant species were collected two of which were exotic species (Eurasian watermilfoil and curlyleaf pondweed). The maximum number of species per site was six. The average number of species per site was 2.23 and average number of natives per site was 1.79. Common coontail was to be the most common species collected with a frequency of occurrence of 77.1 and a dominance rating of 49.7. Milfoil was the second most abundant species collected with a frequency of occurrence of 40.0 and a dominance rating of 11.4. Southern naiad ranked third followed by brittle naiad, American pondweed, leafy pondweed, sago pondweed, chara, and curlyleaf pondweed.

Table 2. Occurrence and abundance of submersed aquatic plants in Waveland Lake, August 15, 2006.

Occurrence and abundance of submersed aquatic plants in Lake Waveland 2006							
County:	Parke / Montgom	Sites with plants:	59			Mean species/site:	2.23
Date:	8/15/2006	Sites with native plants:	59			Standard error (ms/s):	0.20
Secchi (ft):	3.0	Number of species:	9			Mean native species/site:	1.79
Maximum plant depth (ft):	11.0	Number of native species:	7			Standard error (mns/s):	0.16
Trophic status	Eutrophic	Maximum species/site:	6			Species diversity:	0.81
Total sites:	70					Native species diversity:	0.75

All depths (0 to 15 ft)	Frequency of	Rake score frequency per species				Plant Dominance
Species	Occurrence	0	1	3	5	
Coontail	77.1	22.9	25.7	17.1	34.3	49.7
Filamentous Algae	45.7	54.3	45.7	0.0	0.0	9.1
Eurasian water milfoil	40.0	60.0	32.9	5.7	1.4	11.4
Southern naiad	32.9	67.1	14.3	2.9	15.7	20.3
Brittle naiad	27.1	72.9	22.9	2.9	1.4	7.7
American pondweed	14.3	85.7	7.1	5.7	1.4	6.3
Leafy pondweed	11.4	88.6	10.0	1.4	0.0	2.9
Sago pondweed	10.0	90.0	10.0	0.0	0.0	2.0
Chara	8.6	91.4	4.3	2.9	1.4	4.0
Curlyleaf pondweed	4.3	95.7	4.3	0.0	0.0	0.9

2.3 2007 Sampling Results

In spring 2007 Aquatic Control completed an Invasive Species Plant Mapping survey to evaluate exotic species areas for future treatment. In August 2007, both Aquatic Control and IDNR performed separate Tier II surveys.

2.3.1 2007 IDNR Tier II Sampling Results

On August 8, 2007, IDNR fisheries biologist completed another Tier II aquatic plant survey on Waveland Lake. This survey was completed just after Aquatic Control completed a Tier II survey on August 6. A Secchi disc reading was taken and found to be 4.0 feet. Nine plant species were collected. Plants were collected at 77% of the sample sites. The maximum number of species per site was 9. The average number of species per site was 1.69 and the average number of native species per site was 1.46. Common coontail was found to be the most common species collected with a frequency of occurrence of 72.9 and a dominance rating of 41.4. Milfoil was the second most abundant species collected with a frequency of occurrence of 21.4 and a dominance rating of 7.1. Leafy pondweed ranked third followed by American pondweed, brittle naiad, southern naiad, sago pondweed, chara, and curlyleaf pondweed (Table 3).

Table 3. Occurrence and abundance of submersed aquatic plants in Waveland Lake, August 8, 2007.

Occurrence and Abundance of Submersed Aquatic Plants - Overall								
Lake:	Waveland		**Secchi (ft):**	4		**SE Mean Species / Site:**	0.17	
Date:	8/8/2007		**Littoral Sites w/Plants:**	54		**Mean Natives / Site:**	1.46	
Littoral Depth (ft):	9.0		**Number of Species:**	9		**SE Mean Natives / Site:**	0.15	
Littoral Sites:			**Max. Species / Site:**	6		**Species Diversity:**	0.76	
Total Sites:	70		**Mean Species / Site:**	1.69		**Native Diversity:**	0.70	

Species	Frequency of Occurrence	Score Frequency				Dominance
		0	1	3	5	
Coontail	72.9	27.1	27.1	24.3	21.4	41.4
Leafy Pondweed	20	80	18.6	1.4	0	4.6
Brittle Naiad	12.9	87.1	10	2.9	0	3.7
American Pondweed	18.6	95.7	4.3	0	0	26.6
Sago Pondweed	5.7	94.3	5.7	0	0	1.1
Southern Naiad	11.4	88.6	8.6	0	2.9	4.6
Chara	4.3	95.7	4.3	0	0	0.9
Eurasian watermilfoil	21.4	78.6	15.7	4.3	1.4	7.1
Curly-Leaf Pondweed	1.4	98.6	1.4	0	0	0.3
Filamentous Algae	45.7					

2.3.2 2007 Aquatic Control Sampling Results

Two surveys were completed by Aquatic Control in 2007 in order to map potential treatment areas, document changes in the plant community, and to determine success or failure of the current control techniques. An invasive species mapping survey was completed on May 8. This survey allowed for the determination of potential control areas and the documentation of any changes in the abundance of invasive species. A Tier II survey was completed on August 6. This survey was completed in order to document success or failure of the control technique and to compare to the 2006 Tier II data. The survey also allows for the documentation of changes in the native plant community.

2.3.2.1 Spring Invasive Mapping Results

On May 8, 2007, an invasive mapping survey was completed on Waveland Lake. A Secchi disc reading was taken and found to be 3.5 feet. The water temperature was 67.5°F at the surface and 55.4°F at the bottom. Dissolved oxygen was 13.9 mg/L at the surface and 0.3 mg/L at the bottom. The thermocline was between 15.0 and 18.0 feet. Sampling indicated the presence of ten plant beds within the littoral zone of the lake (Table 4 & Figure 1). Coontail was observed in all plant beds in densities from 30% to 100%. Milfoil densities greater than 10% were found in areas 1,3,5,6, and 7. Milfoil had the highest densities in beds 3,5, and 7 where it was greater than 50% abundance. Curlyleaf pondweed was found in densities greater than 10% in areas 1,4,6, and 10.

Table 4. Waveland Lake, Plant bed description, May 8, 2007.

Area	Size (acres)	Description	Color Code
1	31.6	Coontail 50%, Eurasian watermilfoil 20%, Curlyleaf pw 10%, Small pw 10%, Sago 5%, Chara 5%	Red
2	14.5	Chara 30%, Small pondweed 30%, Coontail 30%, Horned pondweed 5%, Sago 5%	yellow
3	3.2	Eurasian watermilfoil 50%, Coontail 40%, Small pw 10%	red
4	49.3	Coontail 65%, Curlyleaf pw 15%, American pw 10%, Small pw 9%, Eurasian watermilfoil 1%	green
5	4.1	Eurasian watermilfoil 50%, Coontail 40%, Small pw 10%	red
6	45.3	Coontail 60%, Small pw 20%, American pw 10%, Eurasian watermilfoil 10%, Curlyleaf 10%	orange
7	12.7	Eurasian watermilfoil 50% and coontail 50%	red
8	5.3	Coontail 90% and Eurasian watermilfoil 10%	orange
9	1.4	Coontail spotty 100% abundance	yellow
10	10.4	Coontail 50% and curyleaf pw 50%	orange

*All littoral areas nealy 100% submersed vegetation coverage

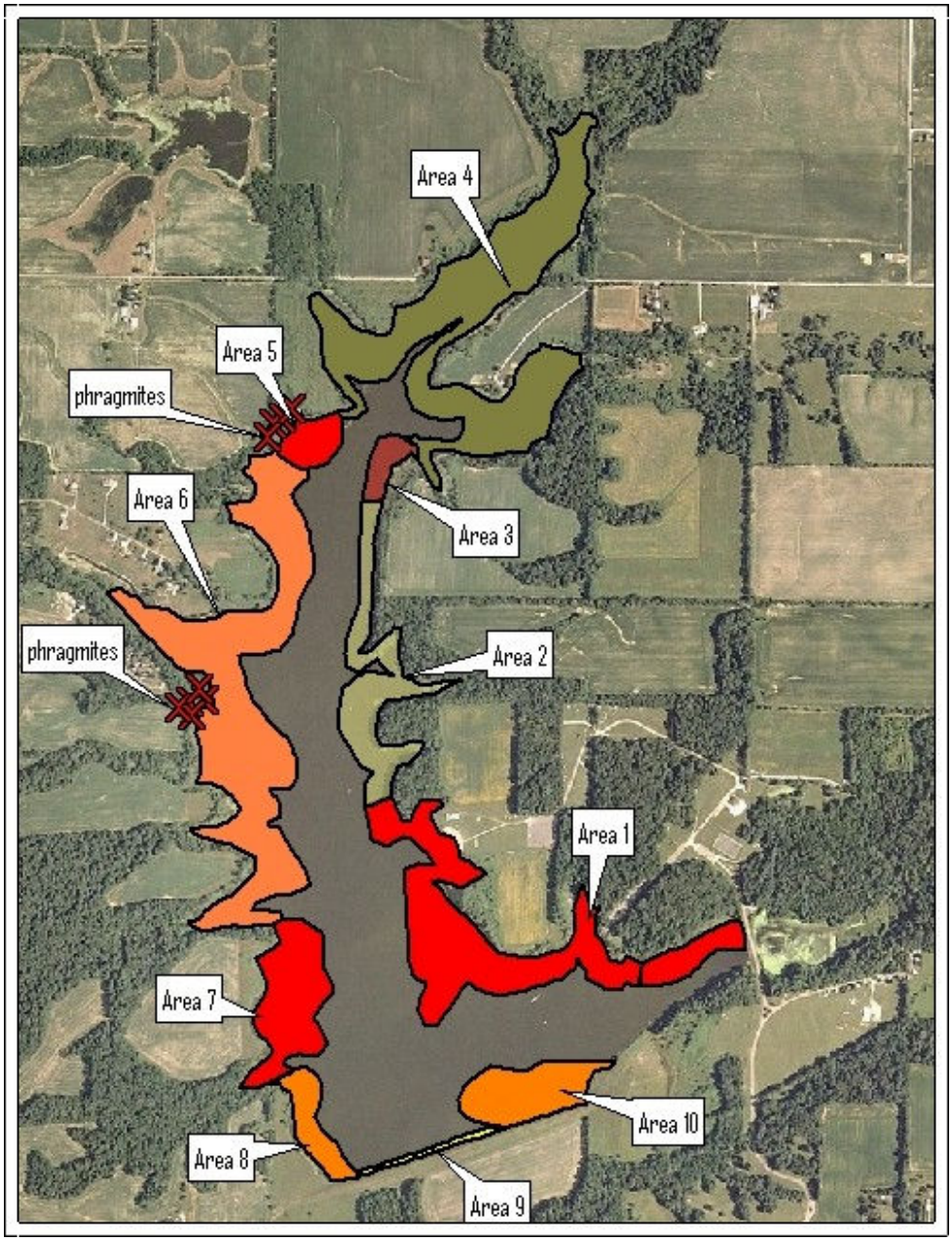


Figure 1. Invasive plant mapping survey, May 8, 2007

2.3.2.2 Summer Tier II Survey

On August 6, 2007, Aquatic Control completed a Tier II survey on Waveland Lake. A Secchi disk reading was taken prior to sampling and was found to be 3.5 feet. Plants were present to a maximum depth of 9.0 feet. Plants were present at 58 out of 70 sample sites and native plants were present at 57 of the sites. A total of 8 species were collected of which 6 of these species were native. The mean number of species collected per site was 1.17 and the mean number of native species collected was 1.07. The species diversity index was 0.53 and the native species diversity index was 0.42 (Table 5).

Table 5. Occurrence and abundance of submersed aquatic plants in Waveland Lake, August 6, 2007.

Occurrence and abundance of submersed aquatic plants in Waveland Lake							
County:	Montgomery	Sites with plants:	58	Mean species/site:	1.17		
Date:	8.6.07	Sites with native plants:	57	Standard error (ms/s):	0.09752937		
Secchi (ft):	3.5	Number of species:	8	Mean native species/site:	1.07		
Maximum plant depth (ft):	9	Number of native species:	6	Standard error (mns/s):	0.09396142		
Trophic status	Mesotrophic	Maximum species/site:	4	Species diversity:	0.53		
Total sites:	70			Native species diversity:	0.42		

All depths (0 to 25 ft)	Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species		0	1	3	5	
common coontail	78.6	21.4	10.0	24.3	44.3	57.4
Eurasian watermilfoil	10.0	90.0	1.4	2.9	5.7	2.0
small pondweed	10.0	90.0	1.4	5.7	2.9	2.0
Brittle naiad	5.7	94.3	0.0	1.4	4.3	2.3
American pondweed	5.7	94.3	0.0	1.4	4.3	1.1
Chara	2.9	97.1	0.0	0.0	2.9	1.1
curlyleaf pondweed	2.9	97.1	0.0	0.0	2.9	0.6
slender naiad	1.4	98.6	0.0	1.4	0.0	0.3

All depths (0 to 5 ft)	Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species		0	1	3	5	
common coontail	91.9	8.1	2.7	21.6	67.6	74.6
small pondweed	18.9	81.1	2.7	10.8	5.4	3.8
Eurasian watermilfoil	16.2	83.8	0.0	5.4	10.8	3.2
American pondweed	10.8	89.2	0.0	2.7	8.1	2.2
Brittle naiad	10.8	89.2	0.0	2.7	8.1	4.3
Chara	5.4	94.6	0.0	0.0	5.4	2.2
curlyleaf pondweed	2.7	97.3	0.0	0.0	2.7	0.5

All depths (5 to 10 ft)	Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species		0	1	3	5	
common coontail	77.8	22.2	22.2	33.3	22.2	46.7
curlyleaf pondweed	3.7	96.3	3.7	0.0	3.7	0.7
Eurasian watermilfoil	3.7	96.3	3.7	0.0	0.0	0.7
slender naiad	3.7	96.3	0.0	3.7	0.0	0.7

Other species observed: creeping waterprimrose, Iris, cattail, purple loosestrife, duckweed, sweetflag, and phragmites

Coontail was by far the most abundant species occurring at 78.6% and a dominance rating of 57.4%. The location and density of Coontail is illustrated in Figure 2. Eurasian watermilfoil and small pondweed tied at 10.0% as the second most abundant species in the survey. Eurasian watermilfoil was collected at 10% of sample sites making it the most frequently occurring exotic species (Figure 3). Other species collected include; brittle naiad, American pondweed, chara, curlyleaf pondweed, and slender naiad (*Najas flexilis*). These species were present in 10% or less of sites. Curlyleaf pondweed was the only other exotic species collected and occurred at 2.9% of the sites. It was most prevalent in the upper end of the lake (Figure 4).

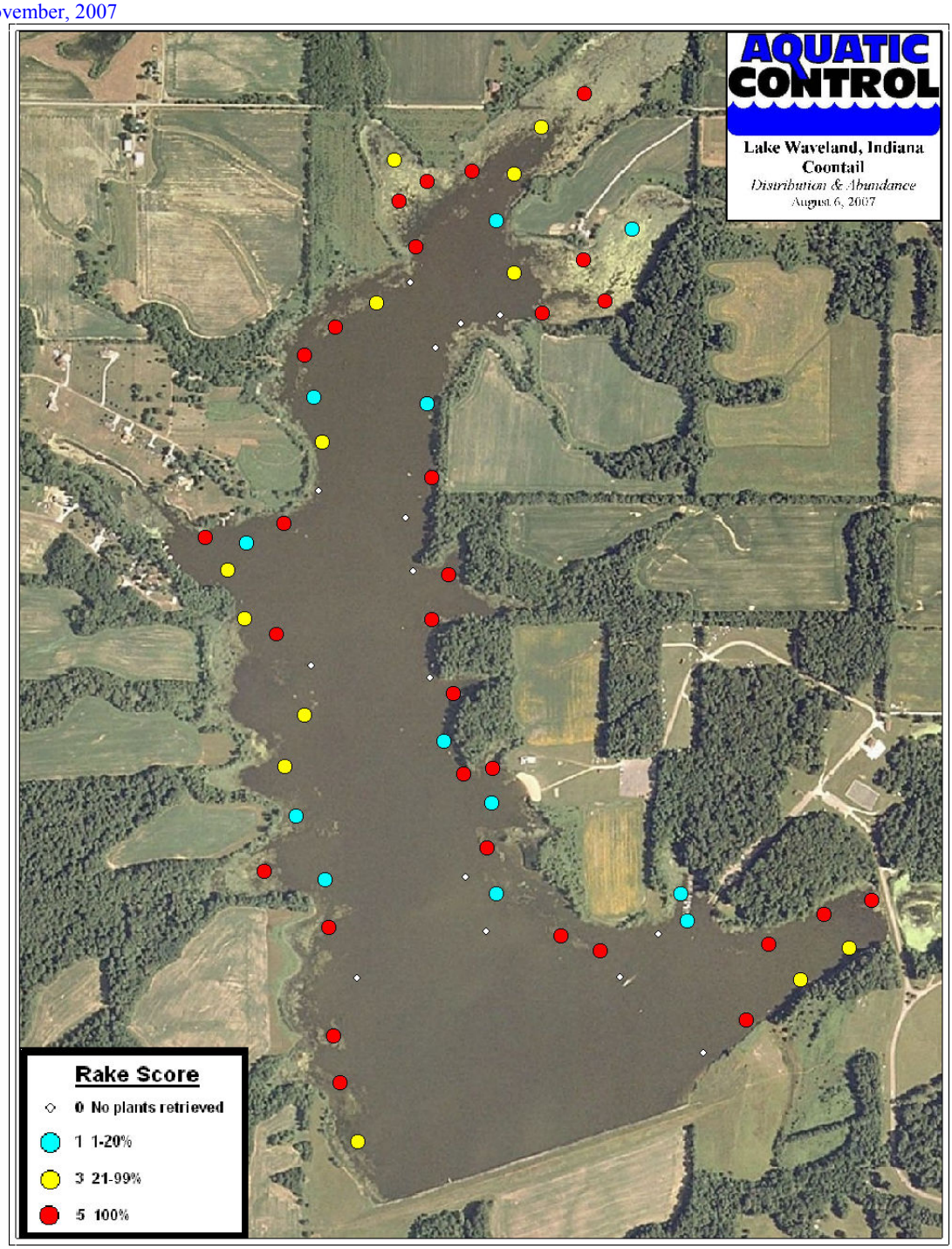


Figure 2. Waveland Lake, coontail distribution and abundance, August 6, 2007.

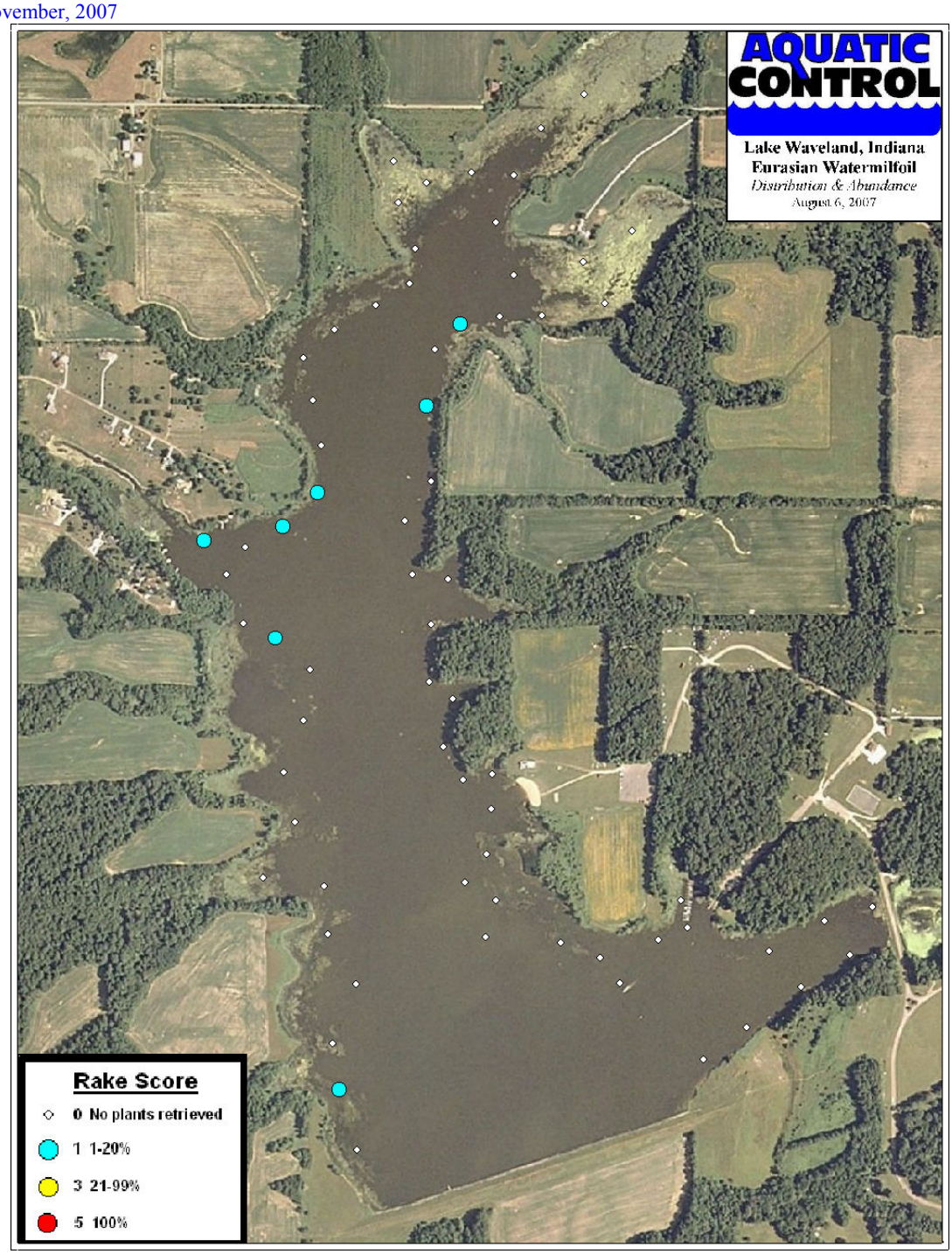


Figure 3. Waveland Lake, Eurasian watermilfoil distribution and abundance, August 6, 2007.

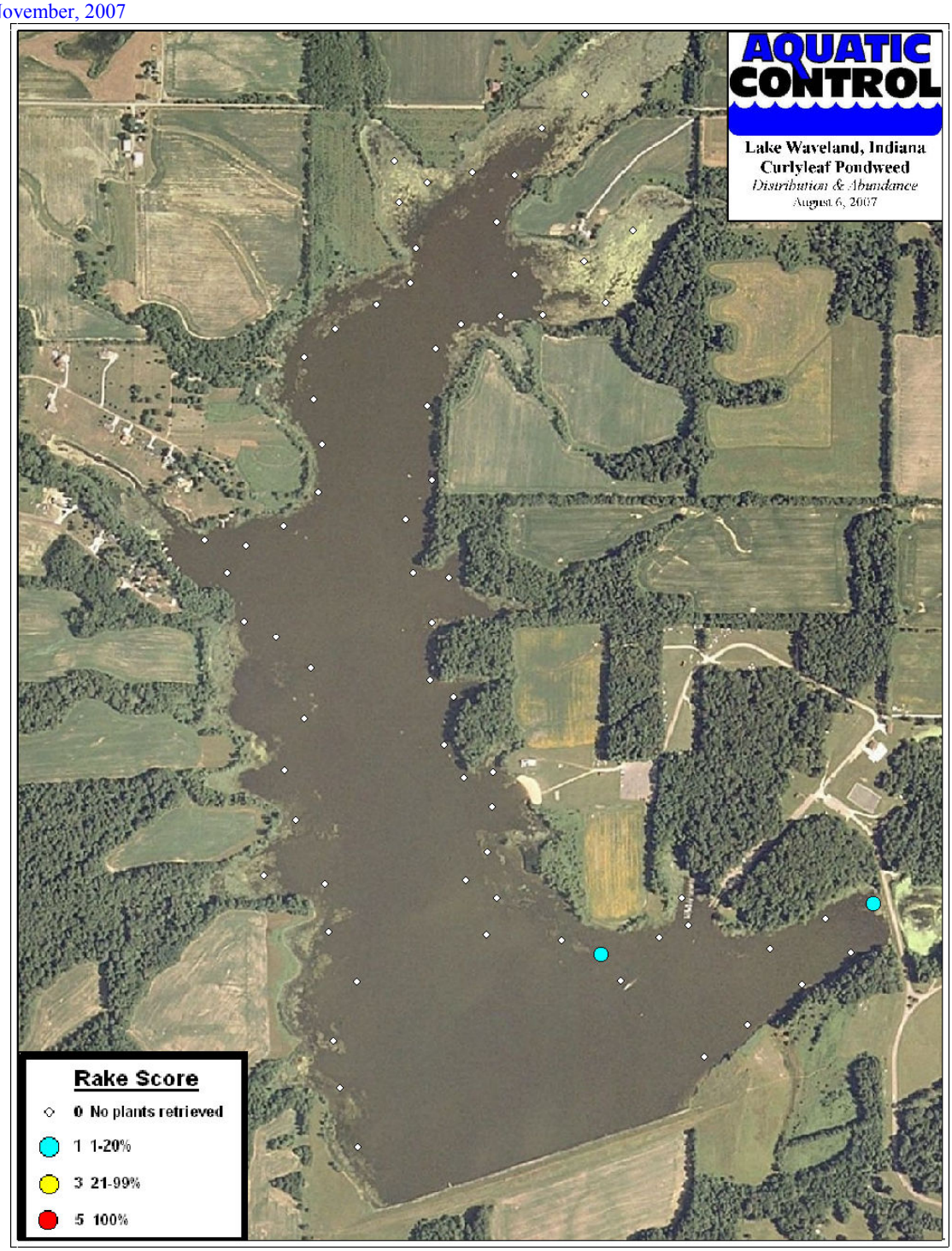


Figure 4. Waveland Lake, curlyleaf pondweed distribution and abundance, August 6, 2007.

2.4 Aquatic Vegetation Sampling Discussion

The two main objectives recommended in the 2005 plan were to reduce the impact of submersed vegetation in high use areas and prevent the spread of exotic species. No action was taken in 2005 or 2006 by Waveland Lake Department of Parks and Recreation to monitor or control milfoil or nuisance native vegetation. IDNR personnel performed Tier II surveys in 2005, 2006 and 2007. In 2007, Aquatic Control was contracted to update the Aquatic Plant Management Plan as well as treat milfoil which was allowed to spread to other areas of the lake. Sampling consisted of invasive mapping in the spring followed by a Tier II survey in the summer.

Invasive mapping appeared to be effective at locating the majority of the milfoil problem areas. This conclusion is reached when comparing the summer Tier II milfoil map to the spring milfoil map. The summer survey did not detect milfoil outside of the areas that were mapped in the spring. Spring invasive mapping also allowed for an acreage estimate on curlyleaf pondweed. This mapping provides a good baseline data set in order to monitor the potential spread of this species and to allow for budget estimates for control.

One of the primary goals of the plan is to reduce the negative impacts caused by nuisance invasive species. The primary exotic species in Waveland Lake is Eurasian watermilfoil. Milfoil was observed but not collected during the 2004 survey. Since then milfoil has spread dramatically to other parts of the lake and become increasingly more abundant. This species exhibited a significant decline this season that can likely be attributed to vegetation controls (Figure 5). This is an excellent example of how fast milfoil, if left untreated, can spread within a lake (Figure 6).

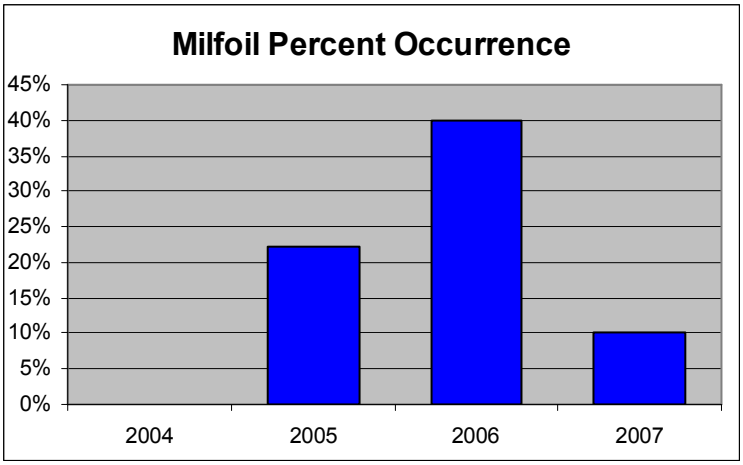


Figure 5. Waveland Lake, Eurasian watermilfoil percent occurrence in the last four summer surveys (2005, 2006 Tier II data provided by IDNR).

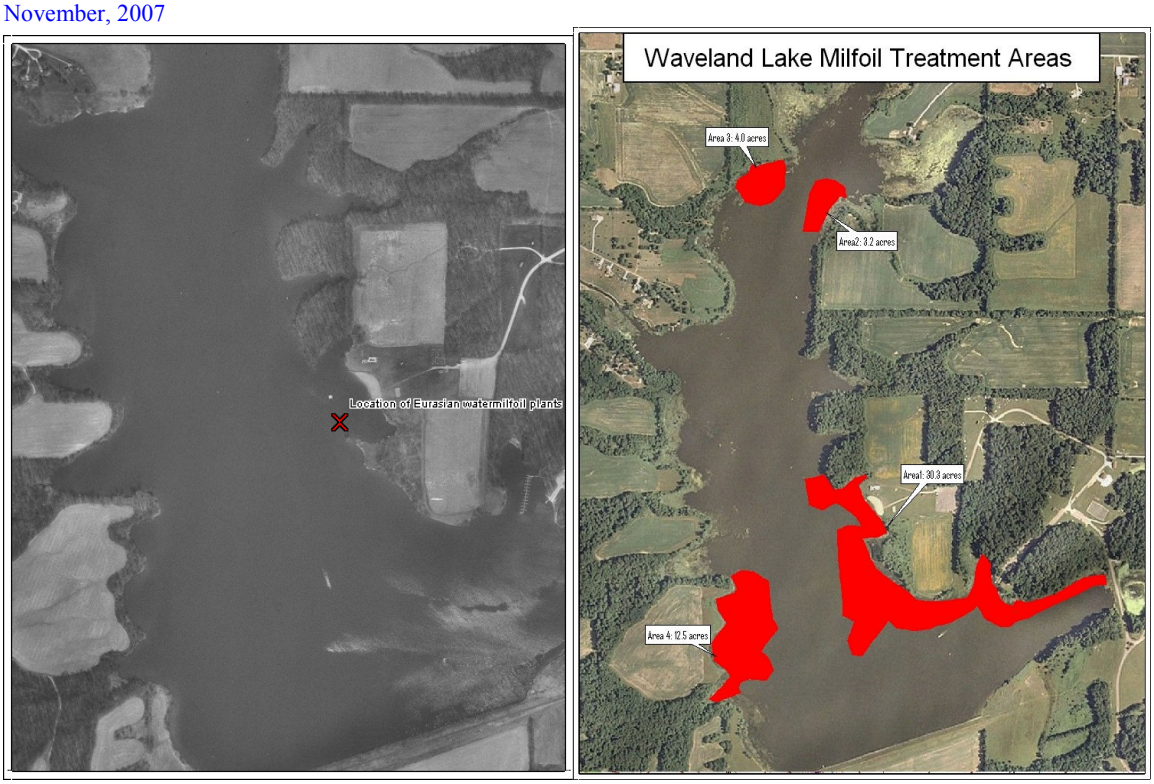


Figure 6. Waveland Lake, comparison of Eurasian watermilfoil spread from 2004 to 2007.

Curyleaf pondweed is another invasive species in Waveland Lake. This species tends to decline by late summer, but still has shown up in the surveys. There appears to have been little change in the abundance of this species in 2006 when compared to past surveys (Figure 7). Curlyleaf was found in abundance during the spring invasive species mapping survey. The decrease in frequency of occurrence of curlyleaf shown in the summer Tier II survey may be due to treatment with contact herbicides in high use areas for nuisance native vegetation. In order to truly understand changes in curlyleaf pondweed abundance, spring Tier II surveys would be needed.

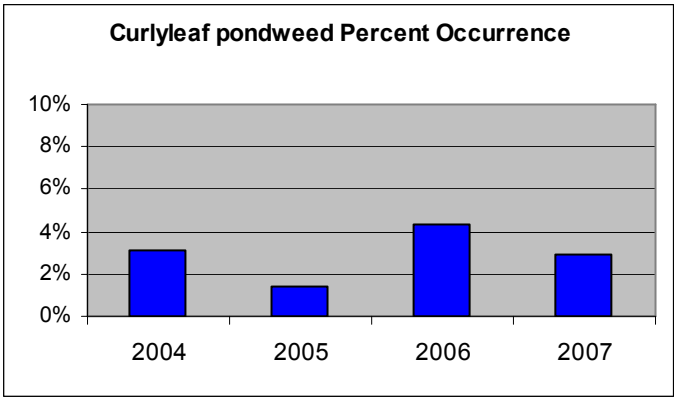


Figure 7. Waveland Lake, Curlyleaf pondweed percent occurrence in the last four summer surveys (2005, 2006 Tier II data provided by IDNR).

Another goal of the original plan was to maintain a stable, diverse, aquatic plant community. The Tier II surveys offer a tool for quantifying changes in the submersed native plant population. Comparison of metrics within the native plant population over the past four surveys revel a slight decrease in native plant density (Figures 8, 9). This may be due to treatment of native species in high density areas.

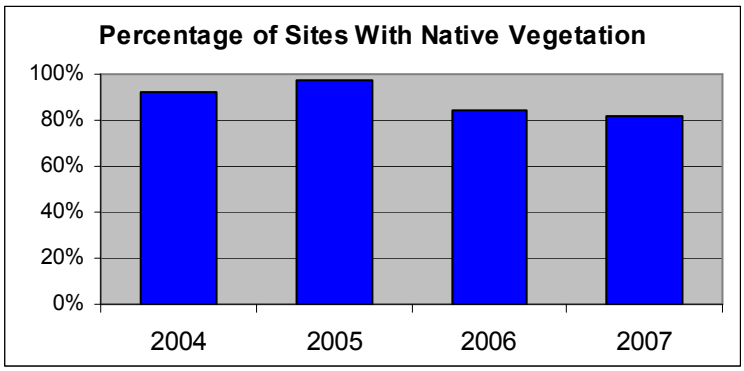


Figure 8. Percentage of sample sites with native vegetation in the last four summer surveys (2005, 2006 Tier II data provided by IDNR)

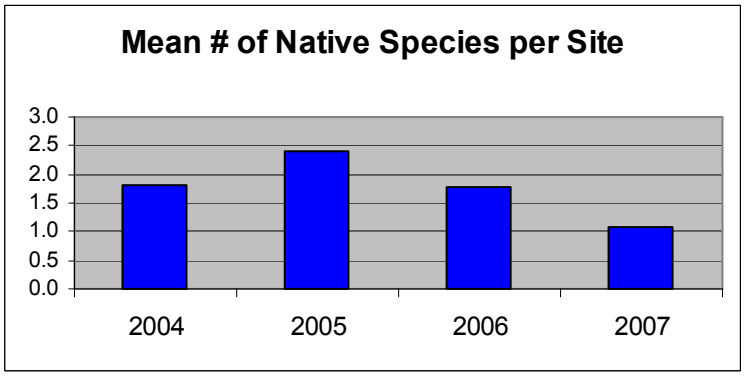


Figure 9. Mean number of native species per site in the last four summer surveys (2005, 2006 Tier II data provided by IDNR)

Table 6 summarizes the data from the past five surveys as it relates to percent occurrence of individual species. Coontail has been the most abundant species found in Waveland Lake. While coontail can be a beneficial native plant, it has become a nuisance to recreation in high use areas. Sago pondweed, leafy pondweed, and southern naiad were not found in the Aquatic Control 2007 summer survey but were collected by IDNR personnel on their survey a few days later (IDNR 2007 Tier II data Table 3). Slender naiad and small pondweed were collected on the AC survey but were not found by IDNR last season or this season. The variability of species composition between Aquatic Control and IDNR data is likely due to the spotty distribution and lower abundance of some native plant species or misidentification of similar species. Reduction in frequency of occurrence was most evident in Eurasian watermilfoil which dropped from 40% to 10% occurrence. This reduction is likely due to selective treatments done earlier in the

season targeting milfoil. The IDNR Tier II data suggests higher frequency of occurrence of milfoil.

Table 6. Percent occurrence of species collected in the last five Tier II surveys on Waveland Lake (2005, 2006 and 8/8/07 data provided by IDNR).

Species	% of survey sites (8/16/04)	% of survey sites (8/11/05)	% of survey sites (8/15/06)	% of survey sites (8/6/07)	% of survey sites (8/8/07)
Eurasian watermilfoil *(Myriophyllum spicatum)*	0.0%	22.2%	40.0%	10.0%	21.4%
curlyleaf pondweed *(Potamogeton crispus)*	3.1%	1.4%	4.3%	2.9%	1.1%
common coontail *(Ceratophyllum demersum)*	49.2%	86.1%	77.1%	78.6%	72.9%
Chara (*Chara spp*.)	3.1%	5.6%	8.6%	2.9%	4.3%
Slender naiad *(Najas flexillis)*	0.0%	0.0%	0.0%	1.4%	0.0%
sago pondweed *(Potamogeton pectinatus)*	21.5%	8.3%	10.0%	0.0%	5.7%
small pondweed *(Potamogeton pusillus)*	16.9%	0.0%	0.0%	10.0%	0.0%
southern naiad *(Najas guadalupensis)*	46.2%	52.8%	32.9%	0.0%	11.4%
leafy pondweed *(Potamogeton foliosus)*	0.0%	30.6%	11.4%	0.0%	20.0%
American pondweed *(Potamogeton nodosus)*	41.5%	30.6%	14.3%	5.7%	18.6%
brittle naiad *(Najas minor)*	0.0%	18.1%	27.1%	5.7%	12.9%
algae		38.9%	45.7%	45.7%	45.7%

In addition, two small patches of *Phragmites australis* were discovered on the west side of the lake (Figure 1). This plant is an exotic species which grows on the shoreline in wet marshy areas. Phragmites can displace native species forming dense monoculture stands. This species has no value to native wildlife populations. Phragmites should be closely monitored in future surveys.

3.0 2007 VEGETATION CONTROLS

In 2007, Waveland Lake Department of Parks and Recreation applied for LARE funding to treat submerged nuisance aquatic vegetation. IDNR biologists recommended aquatic vegetation treatments to improve fish habitat and lake access to the public and residents living on the lake. Based on the recommendations, LARE granted $18,000.00 for milfoil control and $4,500.00 for plan updates and plant survey work. Waveland Parks funded spot treatments for nuisance native vegetation control (primarily coontail) in high use areas. Based on the spring invasive plant mapping survey 50 acres of milfoil were targeted for treatment. More than 50 acres of milfoil existed however funds were not available to treat more than 50 acres. On June 7, 2007 Aquatic Control applied 2,4-D granular herbicide (Navigate) to four treatment areas (Figure 10). This treatment was completed with a boat fitted with a blower system to broadcast the granular herbicide. A GPS device was used in order to achieve accuracy in herbicide target areas.

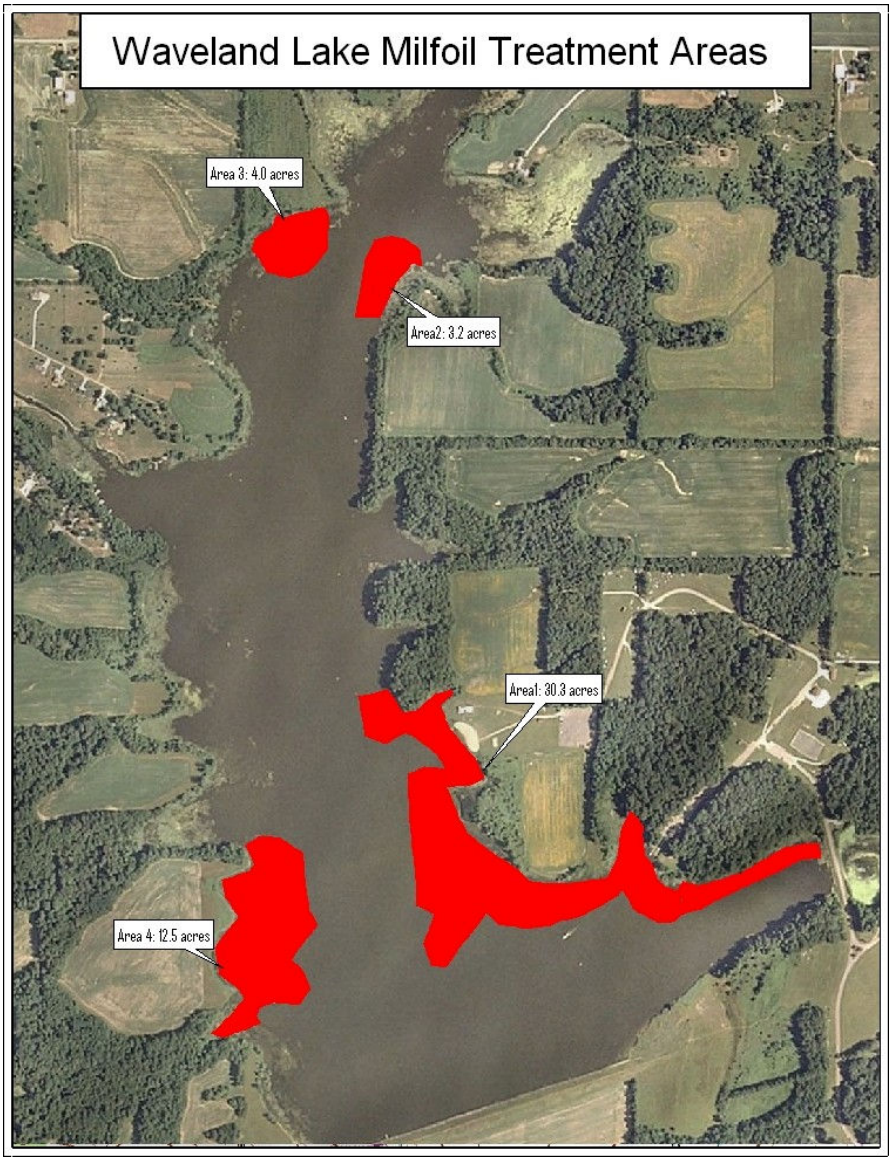


Figure 10. Waveland Lake Eurasian watermilfoil treatment areas June 7, 2007.

Waveland parks department funded a total 20.8 acres of treatment for nuisance native aquatic vegetation occurring in high use areas. On June 20 Aquatic Control completed treatment using Aquathol K (active ingredient endothal), Reward (diquat) and Komeen (copper based). Aquatic application boats fitted with dropper hoses were used to apply the product. Areas designated for treatment were downloaded onto GPS devices in order to insure accurate application. (Figure 11). A larger amount was initially intended to be treated. Dense microscopic algae bloom as well as low dissolved oxygen levels prevented a large scale treatment. Future treatments for dense vegetation in high use areas should be implemented earlier in the season to avoid potential dissolved oxygen problems.

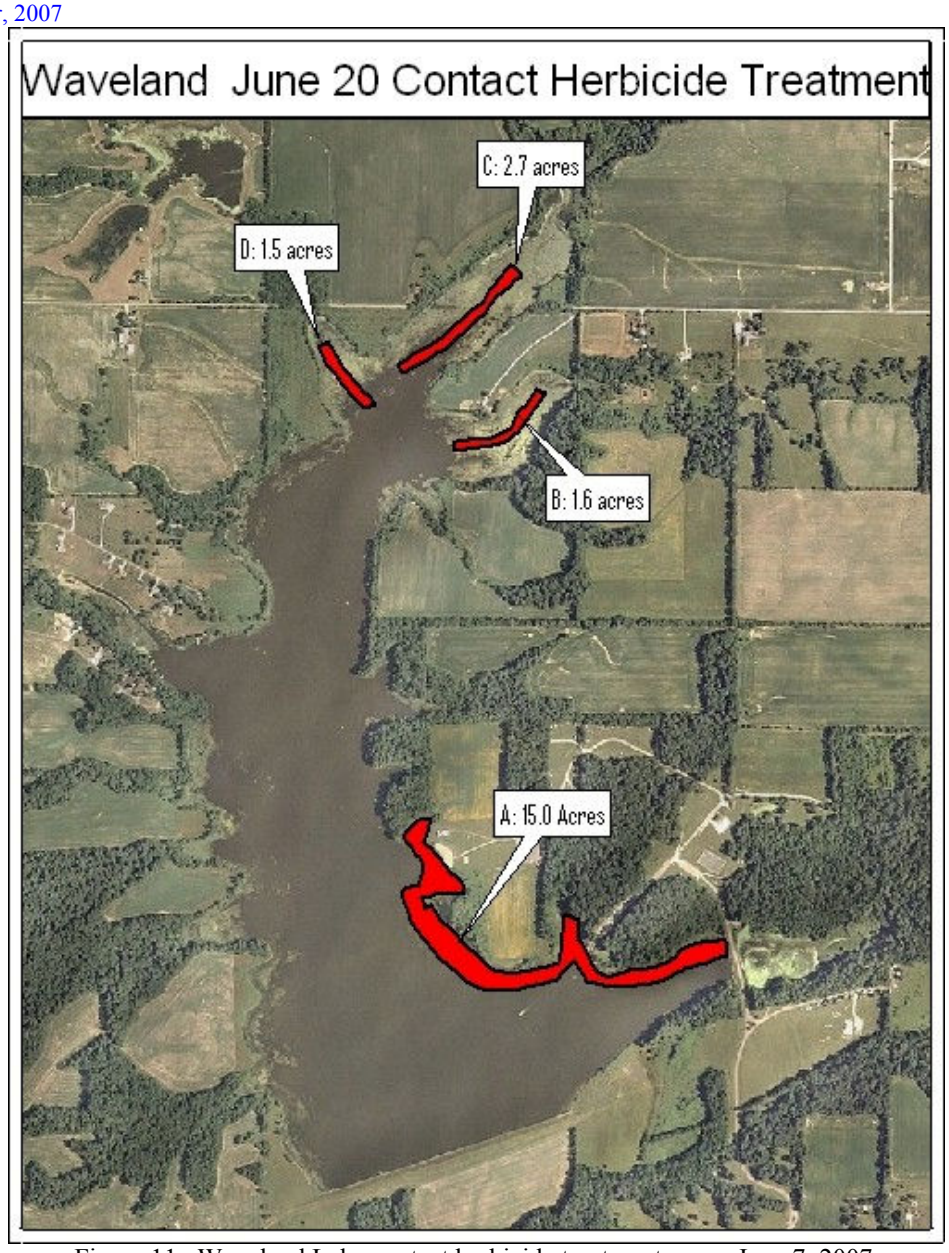


Figure 11. Waveland Lake contact herbicide treatment areas, June 7, 2007.

4.0 PUBLIC INVOLVEMENT

A public meeting was held on September 25, 2007 in Waveland. Approximately 5 lake users attended the meeting along with IDNR District 5 fisheries biologist Rhett Wisener and assistant biologist Jamie Smyth. A survey of lake users was also distributed at the meeting. Results of this survey are summarized in Table 7.

Table 7. Waveland Lake Public Meeting Lake User Survey, Setember 25, 2007.

Waveland Lake User Survey 9/25/07		
Are you a lake property owner?	Yes 0%	No 100%
Are you currently a member of your lake association?	Yes 0%	No 100%
How many years have you been at the lake?	2 or Less: 66.6%	5 to 10: 0%
	2 to 5: 0%	Over 10: 33.3%
How do you use the lake (mark all that apply)	0% Swimming	0% Irrigation
	60% Boating	0% Drinking water
	80% Fishing	0% Other _____
Do you have aquatic plants at your shoreline in nuisance quantities?	Yes: 40% No: 20% (40% no response)	
Does aquatic vegetation interfere with your use or enjoyment of the lake?	Yes: 80% No: 0% (20% no response)	
Does the level of vegetation in the lake affect your property values?	Yes: 0% No: 20% (80% no response)	
Are you in favor of continuing efforts to control vegetation on the lake?	Yes: 100% No: 0%	
Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded?	Yes: 100% No: 0%	
Were you satisfied with the results of the LARE funded invasive treatments this season?	Yes: 100% No: 0%	
Mark any of these you think are problems on your lake:		
0% Too many boats access the lake		
40% Use of jet skis on the lake		
0% Too much fishing		
0% Fish population problem		
80% Dredging needed		
0% Overuse by nonresidents		
40% Too many aquatic plants		
0% Not enough aquatic plants		
20% Poor water quality		
0% Pier/funneling problem		

Another topic discussed at the public meeting was the recent discovery of Hydrilla (*Hydrilla verticillata*) in Lake Manitou. Hydrilla is an invasive aquatic species that was originally discovered in Florida in the 1960's. There are many characteristics of hydrilla that make it a threat to Indiana waterways. This species can grow in lower light conditions than most native species, grows faster than most native species, and can shade out other species by forming a surface canopy. Hydrilla can be easily confused with native elodea. The best way to distinguish Hydrilla is that it typically has five leaves along each whorl along with visible serrated edges along the leaf margin (Figure 12). What makes controlling the spread of Hydrilla difficult is the fact that it can be spread by fragmentation. **That is why it is vitally important that lake users remove all plants and sediment from their boats when entering and leaving Waveland Lake.** More information about controlling the spread of Hydrilla can be found at www.protectyourwaters.net.

Figure 12. Illustration of Hydrilla on the left compared to native elodea on the right. Hydrilla typically contains five toothed leaves per whorl while native elodea typically has three leaves per whorl and the teeth are not visible on the leaves (Illustrations provided by Applied Biochemist).

5.0 ACTION PLAN AND BUDGET UPDATE

In 2007, the vegetation management action focused on the control of milfoil and spot treatment of dense native vegetation in high use areas. LARE funded $18,000 of the treatment cost while the Association picked up the remaining expenses. Funding was not available to treat all of the milfoil areas however the treatments were effective at significantly reducing milfoil abundance in 2007. The key to the plan is providing some long-term control of milfoil. In order to achieve long term control, any remaining areas of milfoil will have to be addressed.

Milfoil was detected during the summer survey which adds to the likelihood that some will be present in 2008. Based on the summer survey and past experience it is estimated that at least 50 acres of milfoil will be present in 2008.

One of the more difficult and important aspects of the action plan will be detection and mapping of the milfoil areas. This should be completed in early to mid May with treatment being completed in mid to late May in order to lessen the likelihood of milfoil spread. If Secchi readings are normal, the majority of mapping can be completed by driving a boat in a tight zig-zag fashion over the littoral area. When milfoil is located, a GPS unit should be used to outline the plant bed. A rake should be used to check for milfoil throughout historical areas of infestation and in the areas marked in Figure 13. A follow-up Tier II survey should also be completed in the summer of 2008 in order to monitor native vegetation and to check on the effectiveness of the potential controls.

Coontail is the primary nuisance species in Waveland Lake. As mentioned before, this species can be beneficial. At present, the over abundance of coontail is interfering with recreational activities such as swimming and fishing and boating. There are high use areas of the lake that will require treatment to control native vegetation, primarily coontail. These areas are high-use areas like, docks, boat ramps, and beaches. Treatments of native vegetation should be limited to these high-use areas and only completed where native vegetation is actually impacting lake use. Figure 13 shows high use areas that would benefit from herbicide treatments.

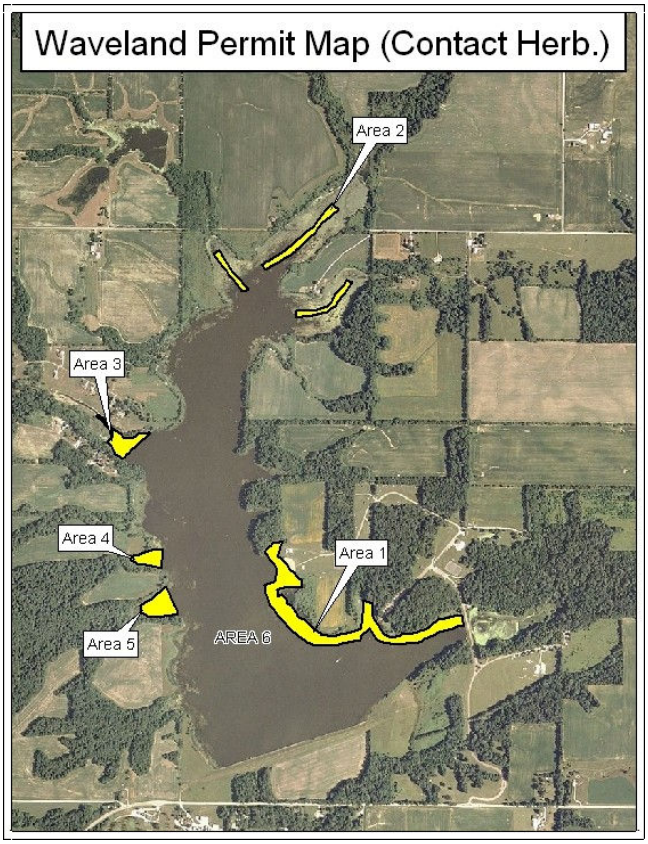


Figure 13. Waveland Lake proposed coontail treatment areas for 2008.

Registered contact herbicides are effective for short term relief of nuisance conditions and ideally a professional should complete the treatment. A professional applicator will have to apply for permits in order to complete such a treatment. However, homeowner's can legally control vegetation in a 625 square-foot areas of their shoreline without a permit. Any vegetation treated with herbicides or manually removed that extends beyond the 625 square foot area will require an IDNR permit.

Efforts to educate residents on the benefits of native vegetation should be continued. This may include annual meetings, newsletters, ILMS conferences or workshops and website postings. Educating residents on the value of native vegetation and proper shoreline maintenance may help enhance the Waveland Lake ecosystem. In addition, educating residents on the need to properly clean boats and trailers may help reduce the movement of invasive species into or out of Waveland Lake.

It is recommended that the Parks department request $24,500 from the LARE program for treatment and the plan update. A total of $20,000 would be for treatment of approximately 60 acres of milfoil, $4,500 would go towards plant sampling and plan updates (Table 8).

Table 8. Updated Budget Estimate.

	2008	2009	2010	2011
2,4-D Treatment for control of Eurasian watermilfoil (Eurasian watermilfoil only)	$20,000	$15,000	$12,500	$10,000
Vegetation Sampling & Plan Update	$4,500	$4,500	$4,500	$4,500
Total:	**$24,500**	**$19,500**	**$17,000**	**$14,500**

6.0 Appendix Update

6.1 2007 Sampling Data-Tier II Survey

Site	Depth	RAKE	Eurasian watermilfoil (*Myriophyllum spicatum*) MYSP2	curlyleaf pondweed (*Potamogeton crispus*) POCR3	common coontail (*Ceratophyllum demersum*) CEDE4	Chara (Chara spp.) CH?AR	Slender naiad (*Najas flexilis*) NAFL	small pondweed (*Potamogeton pusillus*) POPU7	American pondweed (*Potamogeton nodosus*) PONO2	brittle naiad (*Najas minor*) NAMI
1	7.0	1			1					
2	4.0	1			1			1		
3	4.0									
4	12.0									
5	6.0	5		1	5					
6	5.0	5			5	1		1		
7	11.0									
8	3.0	3			1			1		
9	14.0									
10	3.0	5			5					
11	9.0	1			1					
12	4.0	5			5					
13	6.0	5			5					
14	3.0	3			1			1		
15	5.0	5			5					
16	15.0									
17	1.0	5			5	3			1	1
18	5.0	5			5					
19	3.0	3						1		
20	13.0									
21	4.0	5			5					
22	5.0	3	1		1					
23	9.0									
24	6.0	1	1							
25	7.0									
26	6.0	5			5					
27	4.0	5			5					
28	3.0	3			1					
29	5.0	5			5					
30	7.0	3			3					
31	7.0	1			1					
32	6.0	3			3					
33	4.0	3			3			1		
34	2.0	5			5			1	1	
35	5.0	5			5					
36	3.0	5			5				1	1
37	2.0	3			3				1	
38	4.0	5			5					
39	4.0	5			5					
40	8.0									
41	7.0	3			3					
42	6.0	5			5					
43	5.0	5			5					
44	7.0	1			1					
45	7.0	3			3					
46	2.0	3	1							1
47	3.0	5	1		5					
48	7.0	1			1					
49	4.0	5	1		5					
50	7.0	3			3					
51	3.0	3			3					
52	4.0	5	1		5					
53	9.0									
54	9.0	3			3					
55	8.0	3			3					
56	3.0	5			1					5
57	5.0	5			5					
58	7.0	1			1					
59	6.0	5			5					
60	11.0									
61	4.0	5			5					
62	3.0	5	1		5					
63	5.0	3			3					
64	8.0									
65	7.0	5			5					
66	8.0	3			3					
67	8.0	3			3		1			
68	4.0	5		1	5					
69	5.0	5			5					
70	5.0	5			5					

6.2 2008 Vegetation Control Permit Application

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT
State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987
☐ Whole Lake ☐ Multiple Treatment Areas
Check type of permit

INSTRUCTIONS: Please print or type information

FOR OFFICE USE ONLY
License No.
Date Issued
Lake County

Return to: Page 1 of 5
DEPARTMENT OF NATURAL RESOURCES
Division of Fish and Wildlife
Commercial License Clerk
402 West Washington Street, Room W273
Indianapolis, IN 46204

FEE: $5.00

Applicant's Name	Lake Assoc. Name	
Larry Servies	Lake Waveland Park Board	
Rural Route or Street		Phone Number
PO Box 186		812-497-2410
City and State		ZIP Code
Waveland		47989
Certified Applicator (if applicable)	Company or Inc. Name	Certification Number
Rural Route or Street		Phone Number
City and State		ZIP Code

Lake (One application per lake)	Nearest Town	County
Lake Waveland	Waveland	Parke/Montgomery

Does water flow into a water supply ☐ Yes ☒ No

Please complete one section for *EACH* treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area #	1	LAT/LONG or UTM's	Center of bed @ N39.88788 W87.08400	
Total acres to be controlled	15	Proposed shoreline treatment length (ft)	4800	Perpendicular distance from shoreline (ft) 200
Maximum Depth of Treatment (ft)	6	Expected date(s) of treatment(s)	late May early June	

Treatment method: ☒ Chemical ☐ Physical ☐ Biological Control ☐ Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Reward, Komeen, or Aquathol

Plant survey method: ☒ Rake ☒ Visual ☐ Other (specify) Based on spring 2007 survey

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Common coontail	x	50
Eurasian watermilfoil	x	20
Small pondweed	x	10
Sago pondweed	x	5
Chara	x	5

Treatment Area #	2	LAT/LONG or UTM's	Channels in upper 3 bays
Total acres to be controlled	5.8	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	5	Expected date(s) of treatment(s)	mid to late May

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Reward, Komeen, and Aquathol

Plant survey method: [X] Rake [X] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Coontail	X	65
Curlyleaf pondweed	x	15
American pondweed	x	10
small pondweed	x	9
Eurasian watermilfoil	x	1

Treatment Area #	3	LAT/LONG or UTM's	Center of bed @ N39.89543 W87.09447		
Total acres to be controlled	2.6	Proposed shoreline treatment length (ft)	1600	Perpendicular distance from shoreline (ft)	200
Maximum Depth of Treatment (ft)	6	Expected date(s) of treatment(s)	mid to late May		

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Aquathol, komeen, and reward

Plant survey method: [x] Rake [X] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Coontail	X	60
Small pondweed	x	20
American pondweed	x	10
Eurasian watermilfoil	x	10
Curlyleaf pondweed	x	10

AQUATIC CONTROL

Treatment Area #	4	LAT/LONG or UTM's	Center of bed @ N39.89106 W87.09295		
Total acres to be controlled	2	Proposed shoreline treatment length (ft)	1000	Perpendicular distance from shoreline (ft)	200
Maximum Depth of Treatment (ft)	5	Expected date(s) of treatment(s)	mid to late May		

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Reward, Komeen, and Aquathol

Plant survey method: [X] Rake [X] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Coontail	X	65
Curlyleaf pondweed	x	15
American pondweed	x	10
small pondweed	x	9
Eurasian watermilfoil	x	1

Treatment Area #	5	LAT/LONG or UTM's	Center of bed @ N39.88921 W87.09245		
Total acres to be controlled	3	Proposed shoreline treatment length (ft)	1200	Perpendicular distance from shoreline (ft)	200
Maximum Depth of Treatment (ft)	5	Expected date(s) of treatment(s)	mid to late May		

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Aquathol, komeen, and reward

Plant survey method: [x] Rake [X] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Coontail	X	65
Curlyleaf pondweed	x	15
American pondweed	x	10
small pondweed	x	9
Eurasian watermilfoil	x	1

Treatment Area #	6	LAT/LONG or UTM's	To be determined following survey
Total acres to be controlled	<50	Proposed shoreline treatment length (ft)	tbd
Perpendicular distance from shoreline (ft)	tbd		
Maximum Depth of Treatment (ft)	9	Expected date(s) of treatment(s)	early to mid May

Treatment method: [x] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. 2,4-D will be used to selectively control milfoil where it occurs

Plant survey method: [ ] Rake [ ] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Common coontail		70
Eurasian watermilfoil	x	10
Small pondweed		10
Brittle naiad		5
American pondweed		3
Chara		1
Slender naiad		1

INSTRUCTIONS: Whoever treats the lake fills in "Applicant's Signature" unless they are a professional. If they are a professional company who specializes in lake treatment, they should sign on the "Certified Applicant" line.

Applicant Signature	Date
Certified Applicant's Signature	Date

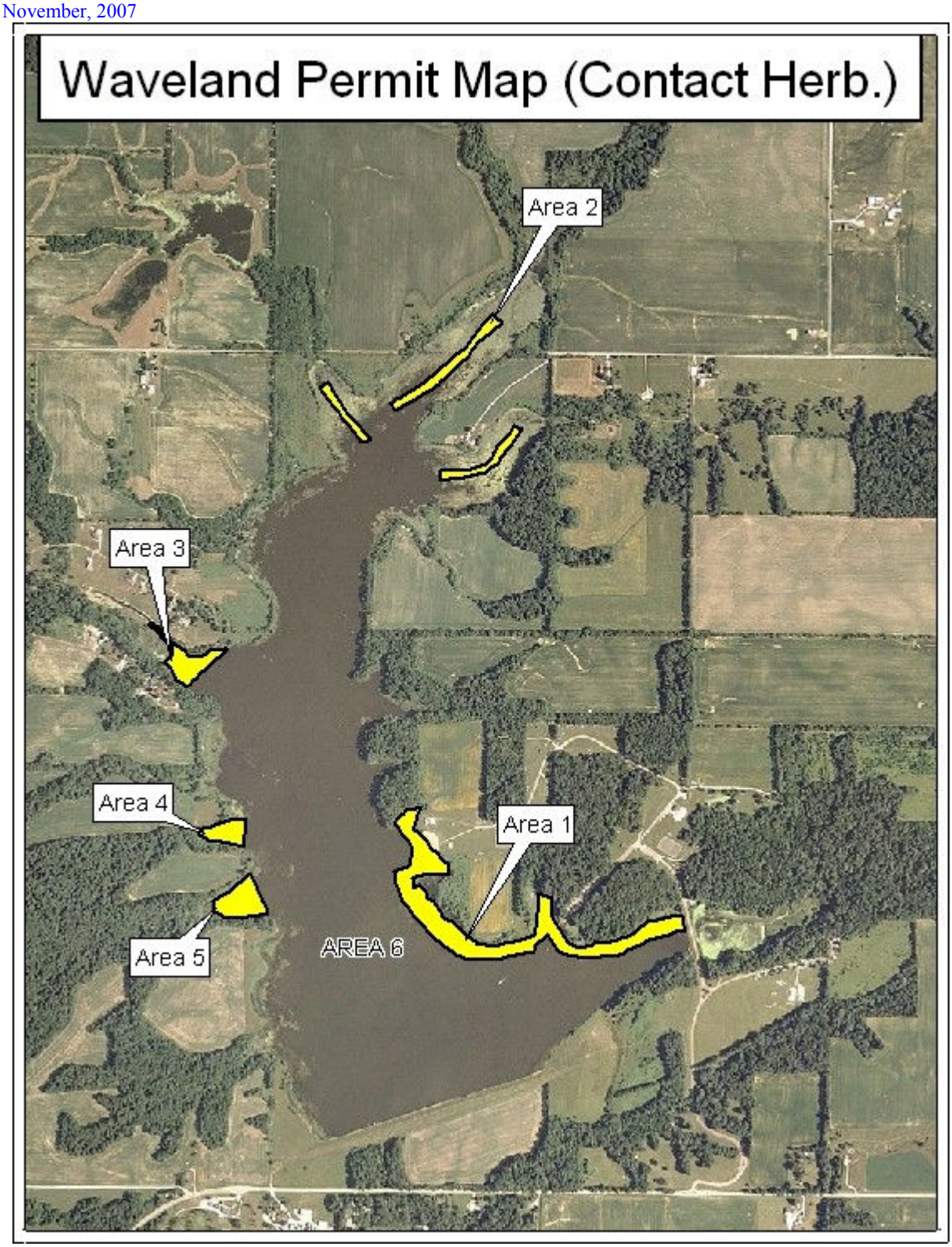
FOR OFFICE ONLY

[ ] Approved [ ] Disapproved	Fisheries Staff Specialist
[ ] Approved [ ] Disapproved	Environmental Staff Specialist

Mail check or money order in the amount of $5.00 to:

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
COMMERCIAL LICENSE CLERK
402 WEST WASHINGTON STREET ROOM W273
INDIANAPOLIS, IN 46204

AQUATIC CONTROL



Vegetation Control Permit Application Map (Page 5 of 5)